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A Ground-Up Approach to mHealth in Nigeria: A Study of Primary Healthcare Workers' Attitude to mHealth Adoption

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Abstract

Mobile Health (mHealth) has been piloted in developing countries to transform the delivery of healthcare services. Despite this heightened focus on mHealth, the number of fully operational mHealth solutions implemented in these locations remains surprisingly low. To extend mHealth projects beyond pilot stage it is imperative that the primary end user is positively predisposed to engaging with the mHealth intervention. Through exploring initial perceptions, we can inform later stages of mHealth projects or develop interventions to convert attitudes into commitment or motivation to use mHealth. This qualitative exploratory study aims to understand end users', namely Primary Healthcare (PHC) workers, initial attitudes towards a mHealth project called IMPACT (usIng Mobile Phones for Assessing, Classifying and Treating sick children). We conducted a field study in Enugu State, Nigeria to understand end users' perceptions of the relevance, benefits, threats and initial understanding of the technology influencing end users' attitudes towards adoption of mHealth. The initial findings indicate that PHC workers expressed positive perceptions regarding the relevance and benefits associated with the IMPACT app. PHC workers focus on how the technology could support them to be more efficient and effective in their roles. However, they advocate the need for community wide education and training to eradicate negative perceptions or misgivings about the potential use of mHealth as part of a patient's assessment.

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1. Introduction

Despite the increased investment from Non-Government Organisations (NGOs), governments, and other funding bodies, in conjunction with and the reported benefits associated with mHealth[1], the number of mobile health (mHealth) solutions operating in developing countries remains extremely low[2]. There are many possible reasons for the low levels of mHealth; from resistance among end users and stakeholders to failure to adequately communicate the aims and benefits of mobile health solutions[3]. Furthermore, it is argued that there exists a limited body of empirical mHealth research in the context of developing countries[4]. It is therefore imperative that we capture the first impressions end users perceive when initially introduced to mHealth projects. This is important to explore as research suggests that early impressions formulated by various end users impact their attitude towards adoption of technology[5]. That is, through these early impressions end users formulate their perceptions about the project[5], and this directly influences their attitudes towards the project. As a result, this paper seeks to explore the first impressions perceived by end users (i.e. Primary healthcare (PHCs workers) when initially introduced to a mHealth project in a developing country (i.e. Nigeria).

The paper is structured as follows: A conceptual model with 4 hypotheses is proposed for examination in the next section. The findings from our field study (conducted in Nigeria) and the implications of these findings for both theory and practice are subsequently presented.

2. Conceptual Model and Hypotheses

This section describes the conceptual model and hypotheses explored as part of this study (see Figure 1).

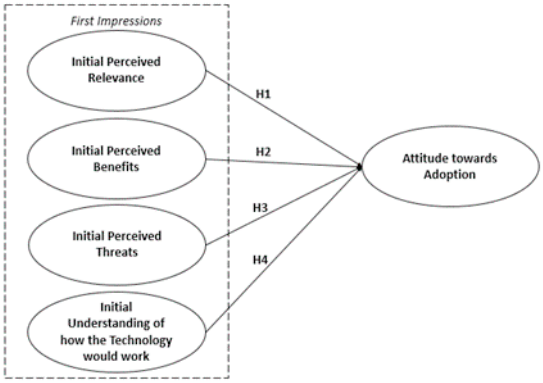

Figure 1: Conceptual Model of Attitudes toward Adoption

2.1. Initial Perceived Relevance

Perceived relevance is a concept that can be subdivided into two categories[6]. The relevance of an ICT development within a healthcare context can be viewed from a macro and micro perspective[6]. The former refers to the extent in which users of Information Technology (IT) (in this case, a mobile health application) will solve problems or help

users realise their actual goals. A micro relevance perspective reflects the extent to which IT assists with solving the 'here-and-now' problems of the users in their daily work routines[7]. For this paper, the definition of perceived relevance builds on the work of Katsma[6] whereby the concept refers to the end users' perception of the apparent value that mobile health based projects hold for them. More specifically, it represents the importance end users' attribute to the new mobile health project. Empirical associations between perceived relevance and attitudes towards new systems have been found, i.e. higher perceived relevance has a positive impact on attitudes toward new systems, albeit not in a mHealth context (Enterprise Systems) [8]. End user adoption behaviour for mHealth depends on the end users' preference to replace the old system[9]. Therefore, the higher the perceived relevance of the mobile health project from an end user perspective, there is an increased positive attitude towards adoption. Thus, it is hypothesized:

H1: Initial Perceived Relevance has an impact on end users' attitude towards adoption of mobile health.

2.2. Initial Perceived Benefits

Research argues that anticipated benefits are a significant predictor of individual behaviours[10]. MHealth are argued to bring about profound opportunities. Benefits for healthcare practitioners (i.e. end users) include improvements in information and time management, enhanced communications and consulting, reference and information gathering source to promote medical education and training, improved clinical decision-making, and better patient monitoring[11]. If the initial perceived benefits associated with the mHealth project are high, end users are more likely to possess positive attitudes towards adopting mHealth. Conversely, if end users perceive few benefits associated with mHealth project then these individuals will acquire negative attitudes towards adopting mHealth. As a result, it is hypothesized:

H2: Initial Perceived Benefits has an impact on end users' attitude towards adoption of mobile health.

2.3. Initial Perceived Threats

Research conducted on the perceptions of the effects of mobile devices on medical data security and privacy and healthcare quality found that mHealth may be subject to unintended consequences such as increased threats to data privacy and security[12]. Eight years previously, it was found that end users perceive data security as one of the central tenets associated with the implementation of an electronic health application[13]. Therefore, higher perceptions of threats, in terms of perceived privacy and security breaches, may negatively impact attitudes towards adoption of mHealth projects. Several other threats have been associated with health technology implementations in developing countries. For example, it was noted that end users of a health information exchange system in Rwanda highlighted issues associated with system use such as network access and reduction in time spent with patients[14]. This system provides an example of health system implementation without reaching scalability. There are often other factors driving end-users' attitudes and actual use of new solutions such as network problems, and time constraints[15]. Therefore, it is hypothesized:

H3: Initial Perceived Threats have a negative impact on end users' attitude towards adoption of mobile health.

2.4. Initial Understanding

It was purported that the absence of knowledge about a target system and limited direct behavioural experience with the system can negatively impact individuals' attitudes towards the adoption of technology[16]. A study on individual differences and conceptual models in training novice users reveals that users' knowledge or understanding of the system will impact their motivation to use it[17]. Building from existing research, it is hypothesized:

H4: Initial understanding of the system has an impact on end users' attitude towards adoption of mobile health.

This study seeks to explore the four hypotheses illustrated in Figure 1 and how each of these impact end users' attitude towards mHealth adoption. The next section outlines the research approach pursued for this study.

3. Methodology

The IMPACT (usIng Mobile Phones for Assessing, Classifying and Treating sick children) project explores the feasibility of introducing a mHealth application in Nigeria for use among PHC workers in their assessment of sick young children. This application offers a low cost mHealth solution, using robust, secure, cloud-based data storage in a rural community, where the reliability of technical infrastructure is a challenge. The project consists of two phases of data collection, the first of which is briefly discussed in this paper. During a week-long visit to Enugu State, Nigeria in September 2016, the project team conducted a qualitative exploratory study engaging with PHC workers (i.e. end users) in healthcare delivery via interviews, presentations, and focus groups. This amounted to over 8 hours of taped interviews/focus groups and over 30 pages of typed field notes. As part of the visit, the project team presented the IMPACT project at Nsukka Health centre and at Parklane Teaching hospital. The presentation outlined the objective of the study and presented the IMPACT app. This was followed by a brief walk-through of the IMPACT app outlining its design and key features. We conducted three focus groups with 20 prospective end users, i.e. PHC workers, of the mHealth technology. It is important to note that this group of PHC workers were highly educated. They all hold bachelors degrees and at least two years training in their roles as primary healthcare workers.

Ethical approval to conduct this study was granted in the home institution in North West Europe and in Enugu State, Nigeria. All interviews and focus groups were transcribed verbatim and hand-written field notes were typed. Using a qualitative analysis approach[18], the data was analyzed using "seed categories"[19] related to the conceptual model (see Figure 1). These categories related to the four hypotheses and included: initial perceived relevance of the mHealth project, initial perceived benefits, initial perceived threats, initial perceived understanding and initial attitudes towards adoption. Data was reviewed by the research team and attributed to the seed categories through several iterations of review.

4. Findings

4.1. Initial Perceived Relevance

In line with H1, PHC workers' impressions on the relevance of the mHealth application to their daily work activities and processes was explored. In each focus group, all PHC workers expressed positive perceptions regarding the relevance of the mHealth application as a tool for aiding them in the assessment and treatment of young children. PHC workers also believed that the mHealth application could improve the effectiveness and efficiency of assessing patients as it enables PHC workers to adhere to guidelines in a timely manner. PHC workers note this would improve on their current processes which require them to utilise a large treatment book and sift through different sections to ask questions about different ailments. When the question seems irrelevant, PHC workers will skip this question thereby not adhering to recommended guidelines. "If someone comes in with fever, cough, and diarrhoea, you have to go to fever page, the cough page and the diarrhoea page and that makes our work very difficult and stressful" (Focus Group 3, Participant 4). The mHealth application enables the seamless transition of questions regarding one ailment to the next in line with treatment guidelines, thereby facilitating adherence to recommended treatment guidelines.

The link between perceived relevance and attitudes towards the application was also apparent and positive as evidenced in quotes such as "I think it will be useful, as I am seeing it now, I like it, I will use it" (Focus Group 2, Participant 3). Furthermore, the importance of perceived relevance was also evident in our focus groups with PHC workers noting that some workers will not use existing information systems if they do not deem them relevant. This is captured in the following quote: "Some people will say it will waste their time and won't like to use it" (Focus Group 3, Participant 5). This strengthens our arguments on the importance of first impressions and incorporating end-users early in the implementation process.

4.2. Initial Perceived Benefits

H2 posited that initial perceptions of the benefits associated with the mHealth application would influence PHC workers' attitudes towards the application. All PHC workers expressed positive views regarding the potential benefits of the application. These benefits included enabling the uniform assessment of all patients, creating reliable records, reducing costs of treatment, improving guardian confidence in treatments, and reducing stress on PHC workers. These perceived benefits also fostered positive attitudes towards the incorporation of the mHealth application into their work processes. This is evidenced in the following quotes. One participant expressed her belief that the application would increase the number of patients visiting the clinics due to the efficiencies it would bring "I think that once we start using this phone, it will make many people come because it will be very easy to test everybody in the clinic" (Focus Group 2, Participant 3). In addition, several participants in Focus Group 2 expressed positive attitudes towards use of the application due to the benefits it could bring noting; "Yes, we would like to use it, we like it, it will help patients, it will motivate the workers". These quotes demonstrate the positive link between perceived benefits and attitudes towards the application and illustrate the need to communicate the benefits to all end users and indeed patients and other stakeholders prior to implementation.

4.3. Initial Perceived Threats

H3 explored PHC workers' perceptions on the threats facing the mHealth application by asking workers about the challenges which may hinder the success of the mHealth application. The initial threats discussed by PHC workers mirror many of the challenges noted in previous studies conducted in developing countries. Many challenges were technical in nature with PHC workers expressing concerns over ensuring network access, software reliability and ensuring devices were adequately charged for uninterrupted use throughout the day. The following quote represents an example of the many current challenges PHC workers face in ensuring mobile devices are charged. "We charge phones with house electricity and when there is no electricity we charge it with generator, but the problem is that sometimes we don't have access to that generator, or the generator has a fault, what can we do about it?" (Focus Group 1, Participant 3). In contrast to our hypothesis, end users did not view privacy or security as a threat associated with the application. This is illustrated in the following quote; "we do not show anybody people's health information" (Focus Group 3, Participant 1). Due to the low perceived threat represented by privacy and security, privacy has no influence on attitudes towards the mHealth application. The link between these perceived threats and attitude was demonstrated in PHC workers' questions on possible solutions as a means of reassurance that the mHealth application would work. This desire for reassurance was evident in statements such as "I need it to diagnose people, how long will the battery last?" (Focus Group 1, Participant 2). Without communicating the backup measures in place to enable charging, PHC workers may believe they application is unreliable and therefore may express negative attitudes. By exploring these threats, the mHealth team can develop mitigation strategies and communication plans to ensure all end users are aware of these measures.

Another perceived threat discussed in the focus groups related to community engagement and support. PHC workers highlighted the importance of educating community members on the reliability of the application to achieve their acceptance. They noted that without such engagement, community members may express negative views towards the application. This is evidenced in the following quote: "Rural dwellers do not have confidence about the result generated in the health centres in the rural areas. If you come up with a programme where the community leaders engage the rural dwellers in a workshop telling them this mHealth app is efficient, that it the same result, and it is better than what you have in the traditional means of diagnosis. Otherwise, it may not be as efficient as we hope" (Focus Group 1, Participant 5). This finding again illustrates the importance of engaging with PHC workers on the ground to illuminate any potential barriers and develop informed mitigation strategies.

4.4. Initial Understanding

In line with the final hypothesis, participants' initial understanding of the functionality and limits of the mHealth application was investigated. Upon viewing the mHealth application, PHC workers demonstrated a cognizant understanding of the basic aim of the application to assess and treat young children and its functions including data

entry, classification, and data storage. The link between understanding and attitudes was also prominent. All PHC workers expressed a willingness to use the application, provided training was received with several participants in Focus group 2 stating "Yes we will use the application if we are taught how to do so". The level of training varied with PHC workers who had previous experience using Android devices noting the application "will not be difficult for us to use" (Focus Group 1, Participant 1). It is imperative to investigate initial understanding as this understanding was linked to the other first impressions as it enabled PHC workers to identify the relevance of this application to their jobs, the benefits and any threats or barriers to their use.

5. Discussion

The introduction of new mobile health solutions is often met with resistance from stakeholders including end users[3]. As this resistance may negatively impact acceptance of mHealth solutions, it is imperative to explore end users' initial perceptions and develop an implementation strategy which (1) highlights the relevance of the solution, (2) outlines the benefits of the solution, (3) describes strategies to mitigate threats and barriers and (4) communicates the aims and functionality of the solution. This section briefly discusses the insights gained from focus groups with end users in Enugu State, Nigeria.

Following the presentation briefing on the new mHealth application, end users' expressed their positive perceptions regarding the relevance of the mHealth solution. They articulated the belief that this application would provide an improvement on existing paper-based data collection and assessment processes. At present, PHC workers often fail to adhere to treatment guidelines due to the length of time required to assess patients. The new mHealth application enables the efficient, uniform treatment of patients in accordance with treatment guidelines. The perceived relevance and improvements realised by the new mHealth solution fostered a positive attitude towards the new solution among PHC workers. Previous research indicates that perceived relevance can drive actual adoption behavior upon implementation of the new system[9]. It can thus be argued that PHC workers' positive first impressions towards the application will pave the way towards acceptance and adoption of the application upon its introduction.

PHC workers expressed the view that the new mHealth application could generate many benefits including data generation and the uniform assessment and treatment of children. In addition, they opined that the new app could improve the ease by which patients could be treated. This adds further empirical support for the benefits of health technologies highlighted by previous researchers[11]. Furthermore, these perceived benefits also manifested in positive attitudes towards adoption of the application. Several threats facing the application were discussed by PHC workers. These included technical threats such as availability of Internet access and electricity issues as well as resourcing issues such as time limits to conduct patient assessments and lack of staff resources at the community clinics. These constraints echo the findings of previous studies in developing countries including network problems, and time constraints[14, 15]. These prior studies noted that these threats hindered the success of health technologies and led to the eventual failure of the system. However, as this study highlights perceived barriers prior to implementation, mitigation strategies can be devised to address these threats and communication strategies developed to educate end users thereby decreasing perceptions of threats and increasing the likelihood of adoption upon implementation. Privacy and security did not represent a threat according to end users, thus refuting assertions made by who asserted that privacy and security represented barriers to mHealth in developing countries[20]. PHC workers developed an initial understanding of the mHealth application, its functions and aims. This understanding fostered positive perceptions towards the relevance of the application to their work processes and tasks, the benefits attainable from use of the application and positive attitudes towards the adoption of the application.

As scalability remain an issue plaguing the success of mobile health in developing countries, the need to engage end users throughout the project to achieve positive attitudes, adoption, and eventual scalability has been highlighted[2]. This paper seeks to engage end users at the pre-implementation stage via informative presentations and focus groups. The findings highlight the influence of end users' first impressions in the formulation of their attitudes towards a new mHealth application. The paper extends existing knowledge by elucidating the influence of first impressions on attitudes towards adoption. While many existing studies explore the attitudes of end users or stakeholders after implementation, this paper illustrates that many perceptions are formulated upon the initial introduction of the application via presentations. By engaging end users prior to implementation, many of the barriers which often hinder implementation and scalability[14] could be adequately addressed thereby improving the likelihood of success. Positive

first impressions can be capitalized upon by developing an informed communication strategy which strengthens these positive attitudes and perceptions on the relevance, understanding and benefits of the application and educates workers on the measures in place to reduce threats. It is believed that such a communication strategy can improve the likelihood of success for new mHealth applications. In the practical sense, the paper highlights the issues which persistently influence the use of mHealth solutions such as Internet and electricity availability and resourcing issues which hinder adherence to treatment guidelines. These issues must be addressed to facilitate not only the success of future mHealth implementations but effective and efficient delivery of healthcare services in developing countries.

6. Conclusion

This research extends understanding and knowledge of participatory behaviour by examining the intention to participate in a mHealth project as opposed to the decision to adopt ICT, for which the latter has underpinned IS research to date. For the most part, end users are positive about the relevance and benefits associated with mHealth. They focused on how this new technology could support them to become more efficient and effective in their roles. PHC workers envisage that mHealth could positively impact the wider community's perception about the quality of healthcare services delivered at the community health centre. Further, it seems that the introduction of mHealth could also act to improve PHC workers motivation in their roles. PHC workers in this study identified challenges associated with the availability of electricity, internet and technical resources as potential threats to mHealth adoption. In addition, the rural community health clinics are challenged by existing negative reputational perceptions amongst the local people. PHC workers advocated the need for community wide mHealth education and training to eradicate any negative perceptions or misgivings about the potential use of mHealth as part of a patient's assessment. In general, PHC workers were confident about their ability to use the mHealth application once they are provided with the adequate training and support to do so.

While the approach used in this study provides rich insights into the perceptions of PHC workers on the ground in Enugu, this qualitative exploratory study among a small sample data does not allow us to understand the extent to which each of the four hypotheses impacts end users attitude toward adoption. It is important to acknowledge that Nsukka is a university town, all of the PHC workers involved in the study had a bachelor's degree, indeed many of them are qualified nurses. We believe that the end user education may also play a role in developing positive perceptions around the possibility of adopting new technology as part of their roles. The sole focus of this research is to understand end users' motivation to engage with a mHealth pilot study. This research does not claim to analyse any impact on user motivation to participate in the subsequent larger scale implementations. Indeed, this study provides participants with a high level view of the mHealth solution and does not endeavour to investigate the usability of the app itself.

This research project promises important translational impacts by equipping PHC workers with the knowledge and skills necessary to effectively undertake to utilise the IMPACT application in the future, thereby improving the delivery of healthcare services to young children in Nigeria. These initial findings prompt us to ask three further research questions: 1) to what extent does each of the hypotheses impact end users' attitude toward adoption, 2) pursuing a community-up approach, how do PHC workers influence the outcome of an mHealth project and subsequent wide scale rollout of the solution?, and 3) as IS researchers, how can we actively promote the successful scalability and long term embeddedness of mHealth in developing countries.

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